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New Asian records and morphological variation in *Fibrodontia brevidens* (*Basidiomycota*)

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Abstract — *Fibrodontia brevidens* (*Trechisporales*) is reported for the first time from Taiwan, mainland China, and Vietnam. Asian specimens are compared morphologically with collections from Venezuela. Morphological variation in the species is discussed. Most variable features within the specimens are encrustation of projecting skeletal-like hyphae (from totally naked to richly encrusted) and spore size. Nevertheless, the single morphospecies concept of *F. brevidens* is retained. Basidioma photographs, microscopical drawings, and scanning electron microscopic photographs of crystalline deposits on skeletal-like hyphae of this species are provided.

Key words — corticioid, *Hyphodontia*, SEM, taxonomy

Introduction

Fibrodontia brevidens (Pat.) Hjortstam & Ryvarden (*Hydnodontaceae*, *Trechisporales*) is a presumably not rare but little collected pantropical corticioid fungus. It has been reported previously from Africa (Rwanda; Ryvarden 1978), Sunda Archipelago (Brunei; Hjortstam et al. 1998), Caribbean Archipelago (Guadeloupe; Nakasone 2003), and South America (Ecuador – Langer 1994; Venezuela – Hjortstam et al. 2005; Brazil – Hjortstam & Ryvarden 2007, S.P. Gorjón, pers. comm.; Uruguay – Martínez & Nakasone 2010). Although there have been numerous studies on the corticioid fungi of mainland China and Taiwan summarized in two recent checklists (Wu 2010, Dai 2011), *F. brevidens* has not been reported earlier for either country.

Morphological descriptions of *F. brevidens* were published by Ryvarden (1978; as *Hyphodontia africana* Ryvarden), Langer (1994; as *Hyphodontia brevidens* (Pat.) Ryvarden), and Nakasone (2003; type of *Acia sericea* Pat.).

The most prominent feature of this species (and the genus in general) are the numerous long parallel moderately flexuous thick-walled hyphae (usually yellowish in mass) that constitute the core of hymenophoral aculei and project at their apices. They have been referred to variously as thick-walled hyphae (Ryvarden 1978), skeletal hyphae (Eriksson et al. 1981, Jung 1987), tubular tramacystidia (Langer 1994), tramal cystidia or pseudocystidia (Nakasone 2003), or pseudoskeletal hyphae (Bernicchia & Gorjón 2010). Similarly, the *Fibrodontia* hyphal system has been described as semi-dimitic (Ryvarden 1978), dimitic (Eriksson et al. 1981), or pseudodimitic (Langer 1994, Bernicchia & Gorjón 2010). An argument for dimiticism is the presence of skeletal hyphae in sterile hyphal textures of the type species, *F. gossypina* Parmasto (Eriksson et al. 1981, Fig. 542). We use the term "skeletal-like hyphae" to refer to these structures in the present paper.

Materials & methods

The reference specimens, collected during 1991–2000 in Asia and South America, are stored in TNM, O, and MSK herbaria (acronyms according to Index Herbariorum, http://sweetgum.nybg.org/ih/). Microscopic structures were measured in material mounted in 3% KOH water solution, and the spore quotient (spore length/width ratio) excludes the apiculus. Encrustations were studied in Melzer's reagent and/or distilled water. The hymenial surface was photographed with Nikon Coolpix P6000 digital camera, while encrusting crystals were photographed with a Hitachi SU 1510 scanning electron microscope.

Results & discussion

Critical study of the collections stored in TNM confirms *Fibrodontia brevidens* as a new record for Taiwan, mainland China, and Vietnam. Taiwanese records are based on two localities, one in central Taiwan and the other on Orchid Island in the Philippine Sea near the southeast Taiwan coast. Two mainland China records represent one site in central Sichuan Province and a second in the extreme south of Yunnan Province. The Vietnamese localities lie in the northern part of the country in the mountains around Ha Noi. The habitats correspond to tropical (from near sea level) and warm subtropical vegetation (up to 1600 m a.s.l.).

Langer (1994) regarded the crystals on skeletal-like hyphae as a common feature in *Fibrodontia*. However, only one (TNM F8714 from Orchid Island) of eight Asian specimens examined had skeletal-like hyphae richly encrusted by characteristic flattened crystals and visible in KOH. To resolve the taxonomic position of specimens with naked hyphae, we compared their general morphology with *F. brevidens* specimens from Venezuela collected by L. Ryvarden.

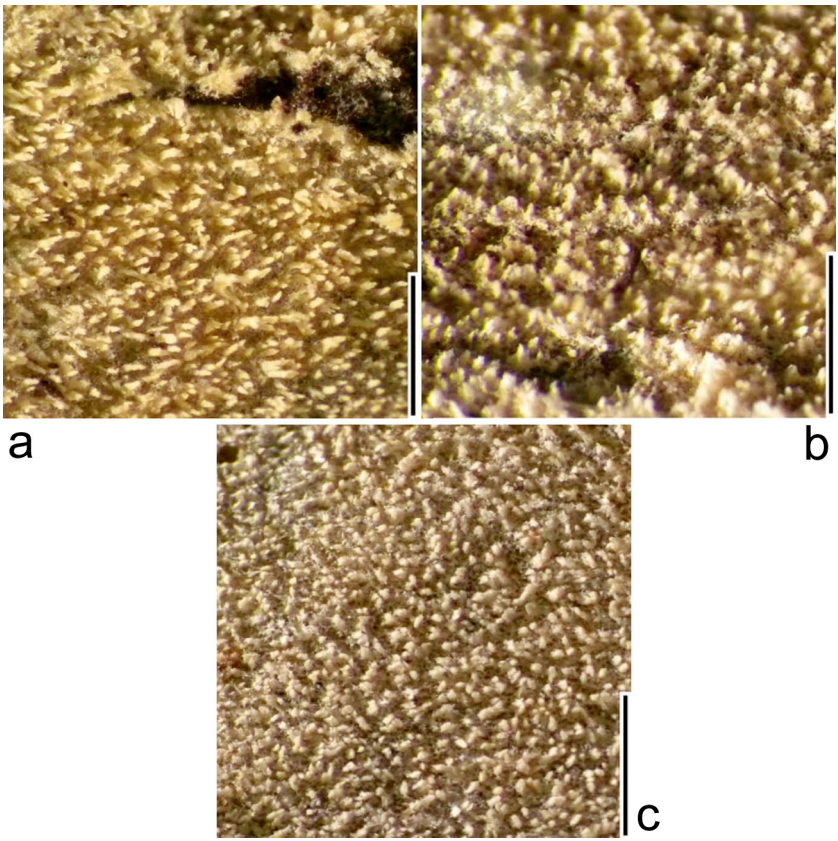

Fig. 1. *Fibrodontia brevidens*. Details of basidiomata: a, TNM F8714 (Orchid Island, Taiwan); b, TNM F24714 (central Taiwan); c, TNM F9008 (Vietnam). Scale bars = 1 mm.

Hymenophore color has been said to vary in *F. brevidens* from white or cream (Langer 1994) to ochraceous (Hjortstam et al. 1998) and greyish orange (Nakasone 2003). However, the Asian and South American specimens we examined were yellowish with olive tinges and not especially variable in color. The hymenophore consists of 50–150 µm tall aculei, which also were not too variable in density and shape (Fig. 1).

The encrustations on skeletal-like hyphae in Asian specimen TNM F8714 resemble those in both Venezuelan specimens (O 37539, O 40434; Fig. 2e, f, h, i). The other Asian specimens have totally naked to unclearly or poorly encrusted skeletal-like hyphae where the crystals were not tablet-shaped and

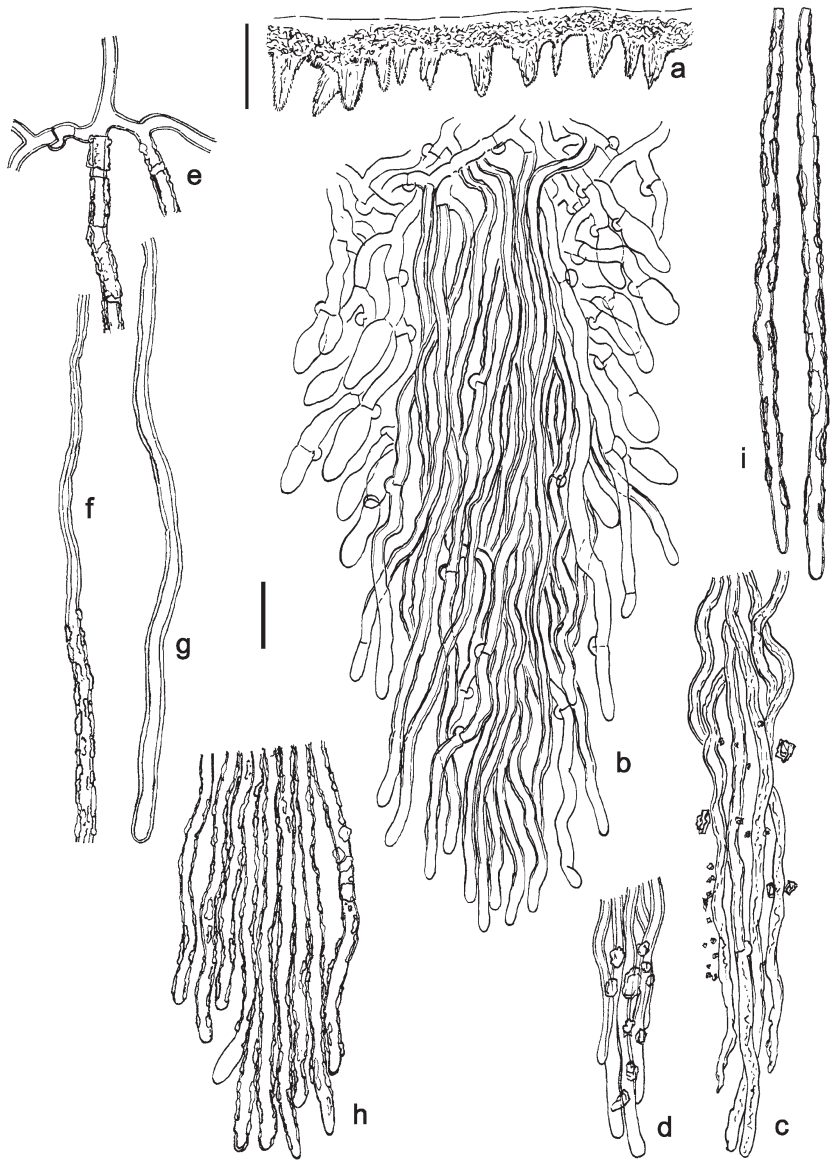

Fig. 2. *Fibrodontia brevidens.* Microscopical elements (TNM F24714): a, vertical section through basidioma; b, vertical section through an aculeus (in KOH solution); c, part of aculeal core (in water). TNM F4188: d, upper parts of skeletal-like hyphae (in water). TNM F8714, skeletal-like hyphae: e, f, in lower part; g, naked one; h, collected in emerging cluster. O 37529: i, skeletal-like hyphae. Scale bars: a = 0.2 mm; b–i = 10 μm.

often only observed in Melzer's reagent or water preparations (Fig. 2b–d). The "encrusted" specimens varied from seldom completely naked (Fig. 2g) to richly encrusted skeletal-like hyphae. Such variability within a single specimen is also inferred from the published descriptions and illustrations of *F. brevidens* (Ryvarden 1978, Langer 1994 – specimen Rammeloo 3929) and *F. gossypina* (Eriksson et al. 1981). Nakasone (2003) provided no data on encrustations on tramacystidia in *Hyphodontia brevidens.* We thus attribute the degree of encrustation to intraspecific variation, partly explained by the developmental stage of each cluster of skeletal-like hyphae.

The shape of the crystals on skeletal-like hyphae in *Fibrodontia* is characterized as tablet-like and partly cuff-like (Langer 1994). However, as their shape is poorly interpreted using light microscopy alone, we compared the two *F. brevidens* skeletal-like hyphal morphotypes (clearly encrusted vs. naked) under the scanning electron microscope. Our SEMs demonstrated that the number and shape of crystals depend on the age of sample examined. The "encrusted" morphotype produced younger aculei with subacicular loosely attached tablet-shaped crystals (Fig. 3a) and older aculei encrusted by numerous tablet-shaped, slate-shaped, and small-sized prismatic crystals (Fig. 3b,c); here no circularly girdling crystals were observed. In the 'naked' *F. brevidens* morphotype, we observed absolutely no encrustations in younger basidioma patches (Fig. 3d), while older aculei contained some skeletal-like hyphae very slightly roughened from scarce minute crystals (Fig. 3e); scattered and loosely attached semi-tablet-shaped crystals were also detected (Fig. 3f).

Published descriptions and our examinations indicate a notable spore size variation within *F. brevidens.* A Venezuelan specimen (O 37539) produced the smallest spores (3.5–4 × 2.5–3.5 µm), and a specimen from Sichuan (TNM F12152; Fig. 5) produced the largest (4.5–5.2 × (3–)3.5–4 µm). Previously published spore sizes vary from 3.5–4 µm in diam (Ryvarden 1978) to 4.5–5(–5.5) × 3.5–4.5 µm (Nakasone 2003).

The large-spored samples from Sichuan and central Taiwan were also distinguished by narrower, more flexuous, loosely arranged skeletal-like hyphae. A large-spored (3.7–4.5(–5) × 3.2–3.5 µm) sample from Taiwan (TNM F24714) had capitate hyphal ends in the subiculum similar to those in *Hyphodontia* (*Xylodon*) species, a character not previously noted for *Fibrodontia* (Fig. 4b). Between collections, spore shape (predominantly broadly ellipsoid and ovoid in *F. brevidens*) was less variable than spore size. Spore quotients within a studied specimen varied from 1 to 1.4; TNM F8714 contained some dorsoventrally flattened spores (ellipsoid in lateral view), with a length : width ratio of 1.6.

Basidial morphology in *Fibrodontia brevidens* differs from that in *Hyphodontia* s. l., which we consider an additional argument for placing *Fibrodontia* in the trechisporoid clade. Basidia in *F. brevidens* are initially

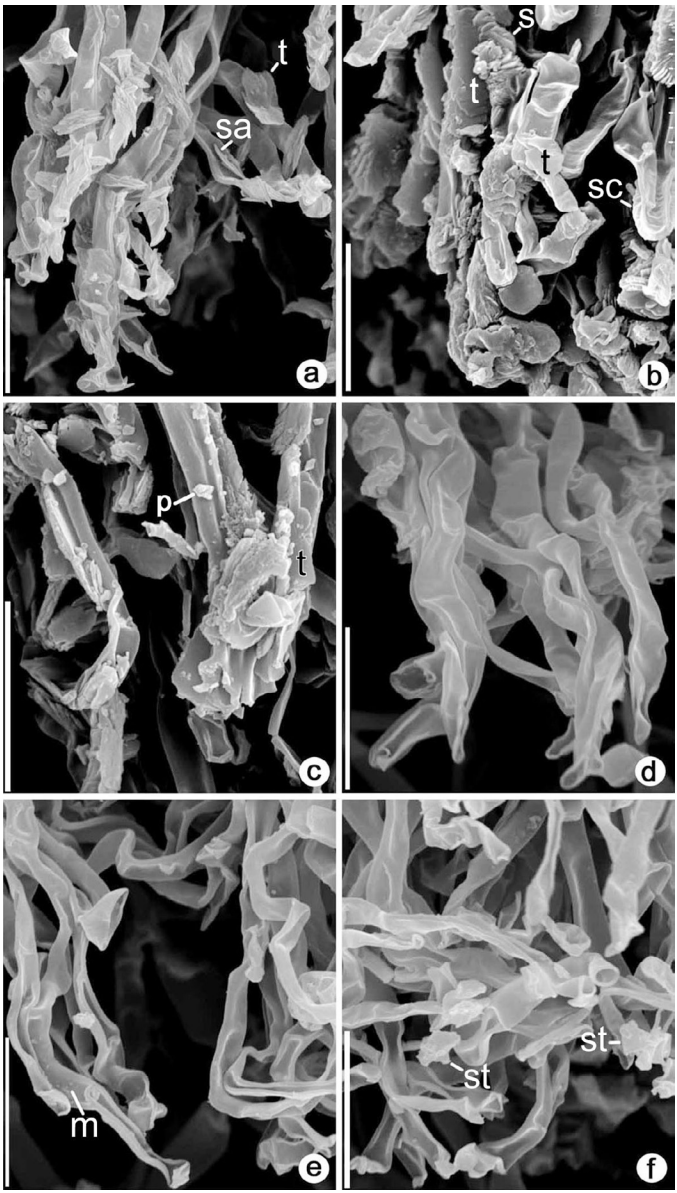

Fig. 3. Scanning electron microscopic images of projecting skeletal-like hyphae and their encrustations in *Fibrodontia brevidens*. TNM F8714: from younger (a) and older (b, c) basidioma patches. TNM F24714: from younger (d) and older (e, f) basidioma patches. The main crystal shapes are marked: m – minute, powder-like; p – prismatic, sa – semi-acicular; s – slate-like; sc – semi-cuff-shaped; st – semi-tablet-shaped; t – tablet-shaped. Scale bars = 10 μm.

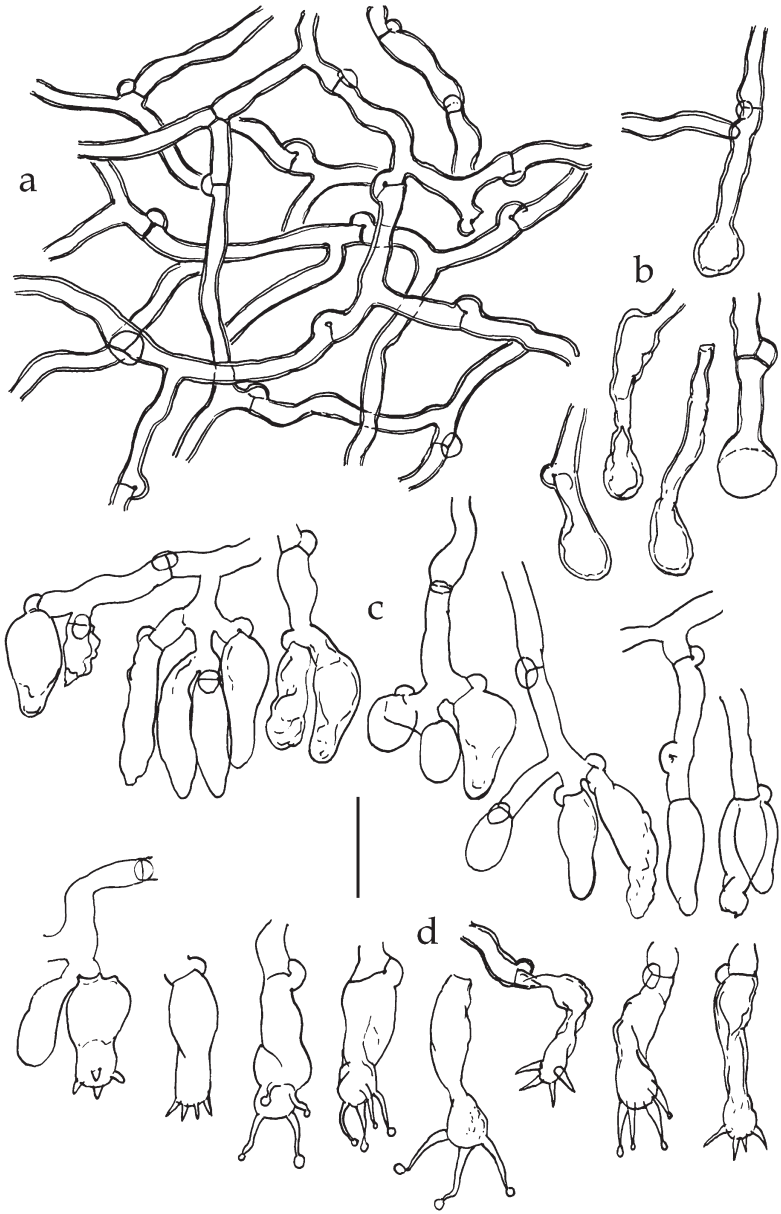

Fig. 4. *Fibrodontia brevidens*. Microscopical elements (TNM F24714): a, subicular hyphae; b, capitate hyphal ends from subiculum; c, basidioles and subhymenial hyphae; d, basidia. Scale bar = 10 µm.

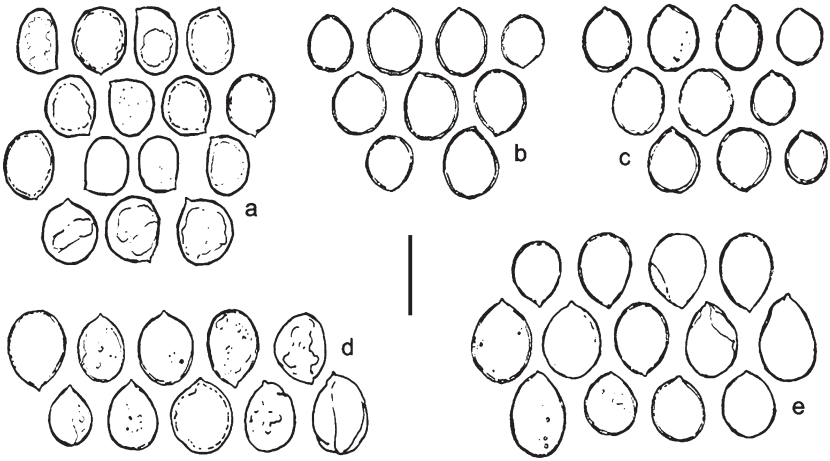

Fig. 5. *Fibrodontia brevidens*. Basidiospore variation: a, TNM F8714 (Taiwan, Orchid Island); b, TNM F4188 (China, Yunnan); c, O 37539 (Venezuela); d, TNM F24714 (central Taiwan); e, TNM F12152 (China, Sichuan). Scale bar = 5 μm.

ovoid, becoming urniform and basally swollen, then more or less utriform with somewhat wavy divaricate sterigmata, and ultimately shrinking and distorted (Fig. 4d).

Except for the encrustations on skeletal-like hyphae and smaller spores (Fig. 5c), we found no significant differences between South American and Asian specimens. From our own observations on variation in *F. brevidens* as well as morphological data by other authors, we regard all studied material as one morphospecies.

Specimens examined — **China: Sichuan**, Chingchenghoushan (Qing Cheng Hou Shan), Feichuankou, 900 m a.s.l., on naked dead wood, S.H. Wu & S.C. Wu, 13.X.2000, Wu 0010-113 (TNM-F 12152); **Yunnan**, Shishuangbanna (Xishuangbanna), Nabanho, 600 m a.s.l., on bamboo stem, coll. S.H. Wu & J.Y. Tseng, 16.VIII.1995, Wu 9508-282 (TNM F4188); on bamboo stem, coll. S.H. Wu & J.Y. Tseng, 16.VIII.1995, Wu 9508-297 (TNM F4203). **TAIWAN: Nantou County**, Luku Hsiang, Sunlinksea, 1600 m a.s.l., on decorticated branch of angiosperm species, coll. S.H. Wu, 11.X.1991, Wu 911011-16 (TNM F24714; dup. in MSK); **Taitung County**, Orchid Island, Yunghsing Farm, on dead branch of angiosperm species, coll. S.H. Wu & J.Y. Tseng, 30.IV.1997, Wu 9704-179 (TNM F8714). **VENEZUELA: Estado Miranda**, Sartenejas, Univ. Simon Bolivar, on dead, partly corticated hardwood, coll. L. Ryvarden, 10.VI.1995 (O 37539); **Estado Amazonas**, Yutajé, on dead naked angiosperm wood, coll. L. Ryvarden, 12-19.VI.1997 (O 40434). **VIETNAM: Ha Noi**, Tam Dao National Park, 1050 m a.s.l., on bamboo trunk, coll. S.H. Wu & S.Z. Chen, 1.VII.1998, Wu 9807-15 (TNM F9007); on dead bamboo stem, coll. S.H. Wu & S.Z. Chen, 1.VII.1998, Wu 9807-16 (TNM F9008); **Ha Tay Province**, Ba Vi National Park, 650 m a.s.l., on bamboo stem, coll. S.H. Wu & S.Z. Chen, 4.VII.1998, Wu 9807-96 (TNM F9081).

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